Effect of routine controlled cord traction as part of the active management of the third stage of labour on postpartum haemorrhage: multicentre randomised controlled trial (TRACOR).

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Should routine controlled cord traction be part of the active management of third stage of labour? The Tracor multicenter randomized controlled trial

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Abstract

Objectives Active management of the third stage of labour is recommended for preventing postpartum haemorrhage (PPH). However, the specific effects of each of its components have not been adequately evaluated. The TRACOR Study aimed to assess the impact of controlled cord traction on the incidence of PPH and other characteristics of the third stage of labour, in a high-resource setting.

Design Randomized controlled trial conducted between January 1, 2010, and January 31, 2011.

Setting Five French university hospital maternity units

Participants Women aged ≥18, with a planned vaginal delivery, at a gestational age ≥ 35 weeks, with a singleton fetus.

Interventions Women were randomly assigned to have third stage of labor managed either by controlled cord traction (CCT), or by standard placenta expulsion (SPE) i.e. awaiting the spontaneous placental separation before facilitating its expulsion. Prophylactic oxytocin just after birth of the baby was administered in the 2 arms.

Main outcome measures The primary outcome was the incidence of PPH ≥ 500 mL as measured in a collector bag.

Results The incidence of PPH was not different in the CCT group (9.8% (196/2005) and in the SPE group (10.3% (206/2008), RR 0.95, 95% CI (0.79 to 1.15). The need for manual removal of placenta was significantly less frequent in the CCT than in the SPE group (4.2%(85/2033) and 6.1%(123/2024), RR 0.69, 95%CI (0.53 to 0.90)); as was third stage > 15 minutes (4.5% (91/2030) and 14.3% (289/2020), RR 0.31, 95%CI 0.25 to 0.39)). Women in the CCT group reported a significantly lower intensity of pain and discomfort during the third stage than those in the SPE group. No uterine inversion occurred in either arm.

Conclusions In a high-resource setting, the use of CCT for the management of placenta expulsion had no significant effect on the incidence of PPH and other markers of postpartum blood loss. Therefore, there is no evidence to recommend routine CCT for the management of placenta expulsion in order to prevent PPH.

Trial registration ClinicalTrials.gov NCT01044082.

"What this paper adds " box

What is already known on this subject

- Active management of the third stage of labour includes the administration of an uterotonic drug immediately after child birth and controlled cord traction (CCT), and is recommended for the prevention of PPH.

- The management of third stage of labour without CCT does not increase the risk of severe PPH in low and middle income countries, and therefore could be omitted in non-hospital settings.

- However, the impact of CCT on PPH incidence and other characteristics of third stage in the context of high-resource settings is unknown.

What this study adds

- In a high-resource setting, the use of CCT for the management of placenta expulsion has no significant effect on the incidence of PPH and other markers of postpartum blood loss. Therefore, there is no evidence to recommend routine CCT for the management of placenta expulsion in order to prevent PPH.

- However, CCT is safe, reduces the length of third stage, the need for manual removal of placenta and for additional uterotonics after placenta delivery, and results in a better experience of the third stage for women.

INTRODUCTION

Postpartum haemorrhage (PPH) remains a major complication of childbirth worldwide. (1) Population-based studies in high-resource countries report a prevalence of severe PPH from 0.5% to 1% of deliveries,(2-5) making it the main component of severe maternal morbidity. Uterine atony is the leading cause of PPH, accounting for 60 to 80% of cases(6). Prevention of atonic PPH is thus crucial, and preventive measures are recommended for all women giving birth, given that individual risk factors are poor predictors.

Active management of the third stage of labour (AMTSL) has been proposed for the prevention of PPH(7). Its standard definition combines the following three procedures: administration of an oxytocic drug immediately after child birth, early cord clamping and cutting, and controlled cord traction. Several trials(8-11) combined in a meta-analysis(12) showed that AMTSL is associated with a 60% reduction in the incidence of PPH compared with expectant management. Given its efficacy, AMTSL has been included in international(13, 14) and national(15-17) guidelines for the prevention of PPH. However, an adequate evaluation of the specific efficacy of each of its components has not been done. The independent efficacy of preventive oxytocics has been shown with a good level of evidence(18) and it is therefore often considered the essential component of AMTSL. This is not the case for controlled cord traction (CCT).(19) Although most guidelines for prevention of PPH include CCT, its actual implementation is highly variable, varying in Europe from 12% in Hungary to 95% in Ireland.(20) In countries, such as France, where CCT is not recommended, pulling the cord in the absence of any sign of placenta separation is considered poor practice because of the potential risk of uterine inversion.(21)

The variation in use of CCT may be explained by the paucity of available evidence for assessing either the efficacy of CCT for the prevention of PPH or its potential risks. Until recently, only two trials conducted in the 1960's (19, 22) and with important limitations had assessed the specific effect of CCT and they had conflicting results. Very recently, a large randomized controlled trial conducted in eight low and middle income countries reported that the omission of CCT as part of AMTSL did not increase the risk of severe PPH(23). The authors concluded that CCT could be omitted in non-hospital

settings. However, the results of this trial may be relevant for low/middle income countries and not applicable to other countries.

The TRACOR Study aimed to assess the impact of controlled cord traction on the incidence of PPH and other characteristics of the third stage of labour, in a high-resource setting.

METHODS

Trial design

The TRACOR (TRAction of the CORd) trial was a multicenter randomized controlled trial with two parallel groups and took place in five French university hospitals between January 1, 2010, and January 31, 2011.

CCT was not a standard part of third-stage management in any of the participating units before the trial. Before the beginning of the trial, all staff likely to recruit women into the trial (midwives and obstetricians) were trained in the trial procedures and more particularly in the technique of CCT. In each participating centre, several training meetings were led by a team from the steering committee pairing a midwife with an obstetrician. Films demonstrated the placement of the collector bag and the practice of CCT. Following this initial training, a period of one month was devoted to using CCT in actual practice. Before the inclusion period, a meeting was organized in each unit to verify the attendants' adherence to the protocol and their ease in practicing the relevant procedures.

Participants

Women aged 18 or more, with a planned vaginal delivery, at a gestational age $\geq$ 35 weeks, with a singleton foetus, were eligible for inclusion. We excluded women with a severe haemostasis disease, those with placenta praevia, in utero foetal death, and multiple gestations. We also excluded women who did not understand French. Eligible women were approached and offered information about the study during a prenatal visit in the third trimester of pregnancy by a midwife or an obstetrician. This information was repeated after their arrival in delivery room for the planned vaginal delivery; the women then confirmed their participation and provided informed written consent.

Interventions

We compared CCT with standard management of placental expulsion.

In the intervention arm, CCT was implemented immediately after the delivery of the baby upon obtaining a uterine contraction, as initially described,(19) according to the following instructions: 1) after birth, CCT is started with a firm uterine contraction without waiting for placenta separation; 2) with one hand, grasp the lower segment between the thumb and index finger and exert steady pressure upwards; 3)at the same time, hold the cord in the other hand, and exert steady cord traction downwards and backwards, exactly countered by the upwards pressure of first hand, so that the position of the uterus remains unchanged. 4) If the placenta is not expelled on the first attempt, repeat CCT with counter-pressure with the next uterine contraction.

In the control arm, the attendant awaited the signs of spontaneous placental separation and descent into the lower uterine segment. Once the placenta was separated, it was then delivered through the mother's efforts (helped by fundal pressure or soft tension on the cord to facilitate placental expulsion through the vagina if needed). This standard placental expulsion (SPE) is the usual management in France, as taught in university hospitals and midwifery schools, and it was the routine procedure in the five participating centers before the trial.

All other aspects of third stage management were identical in both arms: IV injection of 5 IU oxytocin within 2 minutes after birth; clamping and cutting the cord within the 2 minutes following birth; placement of a graduated collection bag (manufactured by MVF Merivaara France, 100 mL graduation) just after birth, left in place until the birth attendant judged that the postpartum bleeding had stopped and that there was no reason to further monitor it(24), and always at least for 15 minutes; manual removal of the placenta at 30 minutes after birth if not expelled. A blood sample was taken from all women on the second day after delivery for the measurement of haemoglobin (Hb) and haematocrit (Ht).

Outcomes

The primary outcome of the trial was the incidence of PPH defined by blood loss ≥ 500 ml, measured with a graduated collector bag (25). The main secondary outcomes were other objective measures of postpartum bleeding: measured blood loss ≥ 1000 mL at bag removal; mean measured blood loss at 15

minutes after birth (the bag had to be left in place at least 15 minutes to have one measure of blood loss at the same time point in all women); mean measured postpartum blood loss at bag removal; mean changes in peripartum haemoglobin and haematocrit (difference between Hb/Ht before delivery and D2). Other secondary outcomes included: supplementary uterotonic treatment, postpartum transfusion (until discharge), arterial embolization or emergency surgery for PPH; other characteristics of the third stage, including its duration, manual removal of the placenta; and women's experience of the third stage, assessed by a self-administered questionnaire on D2 postpartum. Safety outcomes included uterine inversion, cord rupture, and pain.

The detail of procedures used to manage the third stage, as well as all clinical outcomes identified during the immediate postpartum, were prospectively collected by the midwife or the obstetrician in charge of the delivery and recorded in the woman's electronic form in the labour room. Other data were collected by a research assistant, independent of the local medical team. An independent Data Monitoring Committee, which met monthly, was responsible for reviewing adherence to the trial procedures, the recruitment and safety data; the quality of collected outcome data was checked in each centre for 10% of the included women, randomly selected, and in all PPH cases.

Sample size

We assumed a 7% incidence of PPH in the absence of CCT. This incidence is that found in the cohort as a whole in the Pithagore6 trial in 6 French perinatal networks in 2006 from a total of approximately 147 000 births.(26) We hypothesized that CCT might explain half of the 60% reduction in PPH incidence described in the meta-analysis measuring the overall effect of active management. To show a reduction of at least 30% in the incidence of PPH in the CCT arm -that is, a PPH incidence of 4.9% or less in this arm , with α =0.05, 1-β=0.80, and a bilateral test, the study required 1990 women with vaginal deliveries in each group, for a total of 3980 patients.

Given the expected proportion of women with a caesarean delivery in labour after randomization (estimated at 5% to 10%), a higher number of women needed to be randomized to include the needed number of women with vaginal deliveries. The decision to stop inclusions was made by the

independent Data Monitoring Committee, which was able to access the electronic inclusion system to determine the real-time cumulative number of randomized women and their mode of delivery.

This sample size provided a 70% statistical power to detect a reduction in the incidence of severe PPH (defined by blood loss ≥ 1000 ml) from 2% to 1% or less of deliveries.

Randomization

Randomization took place after women completed the participation form, during labour and before delivery. It was performed centrally through an automated web-based system, which ensured allocation concealment. Allocation was stratified by centre.

Statistical methods

The two groups were compared for main and secondary outcomes in an intention-to-treat analysis. The effects of CCT were expressed as mean differences with their 95% confidence intervals for quantitative outcomes, and as relative risks with their 95% confidence intervals for categorical outcomes. To test the consistency of the primary outcome across centres, we used the Mantel-Haenszel homogeneity test. The incidence of each adverse event (cord rupture and uterine inversion) was expressed as a proportion with binomial exact confidence intervals.

An analysis including women who had a caesarean delivery after randomization (for a total of 2172 and 2180 women in the CCT and SPE groups, respectively), for secondary outcomes available in these women (mean change in Hb, mean change in Ht, postpartum transfusion, arterial embolization or emergency surgery) was conducted.

A post-hoc "per protocol" analysis was conducted among women who were managed in accordance with the protocol and the allocation, i.e who had all the following procedures: prophylactic oxytocin administration at birth, cord clamping and cutting within 2 minutes, management of placenta expulsion in accordance with the allocation group (CCT or SPE) and blood collection bag left in place at least 15 minutes.

Software used for analysis was Stata 10.1 (Stata Corporation, USA).

Ethics

The trial protocol was approved by the Paris-Ile de France III Committee for the Protection of Research Subjects (Ethics Committee) in September 2009 (n°B90885-20).

Registration

This trial is registered (ClinicalTrials.gov), number NCT01044082.

The full trial protocol can be accessed at: http://www.u953.idf.inserm.fr/page.asp?page=5211

RESULTS

Figure 1 shows the trial profile. The trial was carried out in all five hospitals between 1 January 2010 and 31 January 2011. In all, 4355 women in labour were enrolled and randomly assigned. After randomization and before delivery, 294 (6.8%) women became ineligible because an intrapartum caesarean was performed, and 3 others declined to participate. Thus 4058 randomized participants delivered vaginally: 2034 assigned to CCT and 2024 to SPE. Baseline demographic and obstetric characteristics were similar in the two groups (Table1).

The management of the third stage of labour is described in Table 2. Overall, the adherence to the protocol was high in both groups. The reasons for deviating from the allocated intervention are detailed in Figure1.

Primary outcome data were collected for 4013 (98.9%) participants. The proportion of women with a measured postpartum blood loss of 500mL or more at bag removal did not differ between the 2 groups (196/2005, 9.8% in the CCT group and 206/2008, 10.3% in the SPE group, relative risk 0.95, 95% CI (0.79;1.15))(Table 3). There was no significant heterogeneity between centres for this result (Table3). Similarly, the incidence of PPH $\geq$ 1000mL at bag removal did not differ between the 2 groups; nor did the mean measured blood loss at 15 minutes and at removal of the bag (Table3).

Outcome data related to blood count indicators before and after delivery were available for 1963/2034(96.5%) women in the CCT group and 1953/2024 (96.5%) in the SPE group (at least one peripartum change in Hb or Ht available). Twenty women (11 in the CCT group and 9 in the SPE group) had transfusion before day 2 and were excluded from this analysis. There was no significant difference in the mean peripartum change in Hb or Ht (Table3). The proportion of women with a

peripartum drop in Hb of 4g/dl or more did not differ between the 2 groups, 2.1% (41/1961) in the CCT group and 1.8% (35/1953) in the SPE group, (RR 1.17, 95%CI (0.75;1.82)).

Women in the CCT group had fewer manual removals of the placenta than those in the SPE group (RR 0.69, 95%CI (0.53; 0.90)) (Table 3). Third stage was shorter in the CCT group.

Regarding safety, no uterine inversion occurred among the 1943 women who had controlled cord traction (incidence 0.0%, one sided 97.5%CI (0.0%-0.18%)). Cord rupture occurred in 89 (incidence 4.6%, 95% CI (3.6%; 5.5%); among those 89 women, manual removal of the placenta was needed in 43 (48%). No other adverse events occurred in the two groups.

Women in the CCT group reported a significantly lower intensity of pain and discomfort during the third stage than those in the SPE group; they were less likely to have felt tired and anxious and to report that the duration of third stage was long (Table 4).

The per-protocol analysis was conducted in 1437/1999(71.9%) women in the CCT arm, and 1574/1990 (79.1%) in the SPE arm. The proportion of women with a measured postpartum blood loss of 500mL or more at bag removal did not differ between the two groups (11.7% (168/1431) in the CCT group and 10.7% (168/1570) in the SPE group, relative risk 1.10, 95% CI (0.90 ;1.34)).

Finally, the analysis including women who had a caesarean delivery after randomization provided results similar to those of the main analysis (data not shown).

DISCUSSION

In this large multicenter randomized trial, we found that the use of controlled cord traction as one component of the active management of third stage of labour had no significant effect on the incidence of PPH. However, CCT reduced the duration of the third stage and the need for manual removal of placenta. Moreover, women in the CCT group reported a significantly lower intensity of pain and discomfort as well as less fatigue and anxiety.

This trial included a large population of pregnant women with few exclusion criteria. Hence, the results are likely to be generalizable to women with vaginal deliveries in similar contexts of care.

Moreover, the adherence to the allocated intervention and other standardized aspects of third stage management was high, making it possible to isolate the effect of CCT.

It was not possible to blind this intervention as the procedures being tested require different actions by the attendants. However, the trial primary and main secondary outcomes (change in peripartum Hb and Ht) were objective measures of postpartum blood loss as opposed to other definitions of PPH based on visual estimation or interventions, influenced by caregiver decisions. Although the quality of the CCT technique was not formally evaluated, a real difference in the management of placenta expulsion between the 2 groups is very likely given the emphasis on the initial training. Moreover, the attendants in the two groups clearly reported different procedures, and the length of the third stage was significantly shorter and the incidence of cord rupture higher in the CCT group.

Two small trials in the 1960's (19, 22, 27) assessed the specific effects of CCT during the third stage. Both had important methodological weaknesses including inadequate method of randomization, visual estimation of blood loss for determining outcome measures and limited sample sizes. Very recently, a large randomized controlled trial conducted in eight low and middle income countries compared CCT with "hands-off " management of third stage(23) . The results showed that the omission of CCT did not result in an increased risk of measured blood loss of 1000 mL or more. However, heterogeneity between centres in other components of third stage management (type of uterotonic used, combination with uterine massage), absence of report on the actual duration of blood loss measurement in each arm and absence of outcomes based on blood counts, may limit the interpretation of the results. In addition, although it is of major importance to conduct research studies in low and middle income countries, the generalizability of their results for high income settings needs to be tested. Indeed, characteristics of women, management of labour, resources and organization of care in the labour ward clearly differ between low and high resource countries, and these differences may impact the risk and the characteristics of PPH. Mechanisms of PPH and effective preventive procedures may differ between settings. It is noteworthy that the incidence of PPH $\geq$ 500 mL in the reference group of the previous CCT trial was about 30% higher than the incidence found in the Tracor trial, which might indicate higher exposure to the risk of PPH. For these reasons, our results provide valuable additional evidence

that CCT is not an essential component of management of the third stage of labour for prevention of PPH, in high resource countries.

Cord rupture occurred in about 1 in 22 women who had CCT. This rate may appear notable at first. However, in the majority of cases (52%), delivery of the placenta occurred without any extra intervention; and overall, the rate of manual removal of placenta was lower in women who had CCT. In consequence, cord rupture should not be considered an important adverse effect of CCT and does not imply manual removal of placenta.

The 30% reduction in the need for manual removal of placenta found in the CCT arm may provide a meaningful decrease in morbidity considering the need for analgesia and antibiotics, separation of mother and baby, and the risk of infection associated with this intervention (28). However, we cannot exclude the possibility that such a difference may have been less important (or even not significant) if the French policy was more conservative, allowing a duration of third stage greater than 30 minutes before manually removing the placenta, in particular in the SPE group. Our finding of a lower risk of manual removal of placenta when its expulsion is managed with CCT is in contrast with the conclusions of the trial cited above(29). However, in this study, manual removal of placenta was performed in less than 1% of deliveries in both arms, which is low in comparison with previous reports from high resource countries (30, 31), and may actually illustrate the variations in policies for the management of the third stage of labour between settings (32). Our trial also showed that CCT significantly reduced the duration of third stage. This result may have implications for optimizing the organization of postpartum surveillance and care, in particular in hospitals where the number of midwives or birth attendants in labour wards is limited. In addition, the shorter third stage and lesser need for manual removal of placenta associated with CCT are likely to be the main reasons why women reported a better experience of the third stage of labour in the CCT arm, although we cannot exclude a patient preference bias since the study was not blinded.

Another controversial aspect of the management of the third stage of labour is the timing of cord clamping. Recent results from a trial conducted in Sweden showed that, even in a region with low prevalence of iron deficiency, delayed cord clamping reduced the prevalence of neonatal anaemia and

improved iron status at 4 months of age in term deliveries (33), confirming the findings of previous trials conducted in low and middle income populations(34). CCT, as it is classically performed, is not compatible with delayed cord clamping. Our finding that CCT has no significant effect on maternal postpartum haemorrhage constitutes reassuring information for clinicians willing to implement a policy of delayed cord clamping, from both maternal and neonatal perspectives.

In a high-resource setting, the use of CCT for the management of placenta expulsion has no significant effect on the incidence of PPH and other markers of postpartum blood loss. Therefore, there is no evidence to recommend routine CCT for the management of placenta expulsion in order to prevent PPH.

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Contribution of authors

CDT participated in the design of the study, obtained funding participated in the central monitoring of data collection, supervised the cleaning, analysis, and interpretation of the data and the drafting and revision of the paper, and has seen and approved the final version. She had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. As the Corresponding Author, she has the right to grant on behalf of all authors and does grant on behalf of all authors, an exclusive licence on a worldwide basis to the BMJ Publishing Group Ltd and its Licensees to permit this article (if accepted) to be published in BMJ editions and any other BMJPGL products and sublicences to exploit all subsidiary rights.

LS participated in the design of the study, supervised the inclusion of women and the running of the trial in his hospital, participated in the revision of the paper, and has seen and approved the final version.

FM participated in the central monitoring of data collection, supervised the cleaning of the data, conducted the analysis and participated in the drafting and the revision of the paper and has seen and approved the final version.

EC participated in the design of the study, supervised the inclusion of women and the running of the trial in his hospital, participated in the revision of the paper, and has seen and approved the final version.

DV participated in the design of the study, supervised the inclusion of women and the running of the trial in her hospital, participated in the revision of the paper, and has seen and approved the final version.

JL participated in the design of the study, supervised the inclusion of women and the running of the trial in his hospital, participated in the revision of the paper, and has seen and approved the final version.

FG is the principal investigator of the trial; he participated in the design of the study, obtained funding for it, participated in the central monitoring of data collection, supervised the cleaning, analysis, and interpretation of the data and the drafting and revision of the paper, and has seen and approved the final version. He had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: had support from the French Ministry of Health for the submitted work; LS had relationships (board membership, consultancy and lectures) with Ferring; other authors had no financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years; no other relationships or activities that could appear to have influenced the submitted work.

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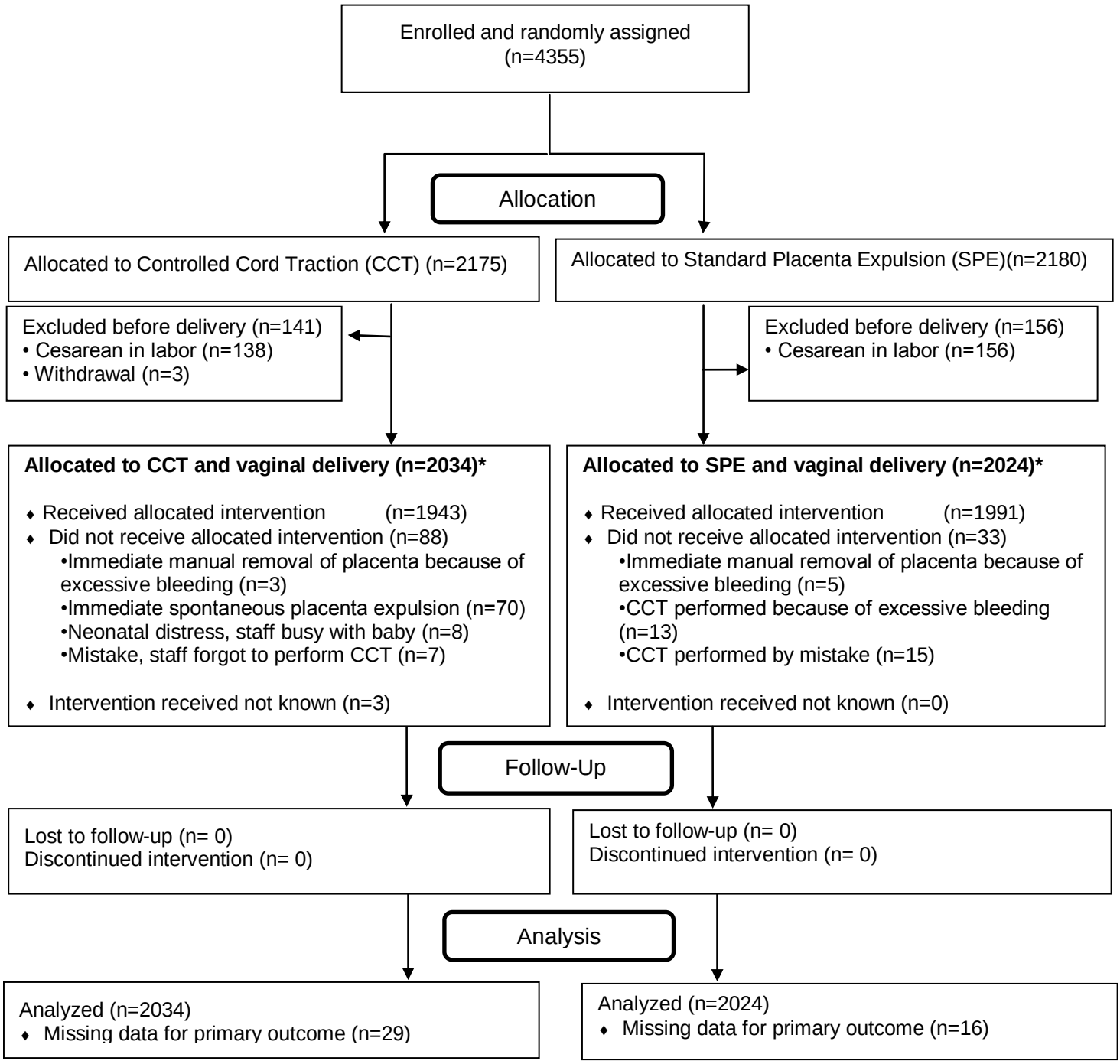
Figure 1: Trial flow diagram



* During the inclusion period, 12 391 women meeting the inclusion criteria had vaginal deliveries at the 5 participating hospitals; the trial thus recruited 32.7% (4058/12391) of the eligible women. The exact number of women assessed for eligibility was not collected.

Table 1. Baseline characteristics of women

Characteristics	Controlled Cord Traction (N= 2034)	Standard Placenta Expulsion (N= 2024)
Hospital		
A	485/2034 (23.8)	489/2024 (24.1)
B	213/2034 (10.5)	202/2024 (10.0)
C	345/2034 (17.0)	332/2024 (16.4)
D	446/2034 (21.9)	443/2024 (21.9)
E	545/2034 (26.8)	558/2024 (27.6)
Age (years) (mean (SD) (n))	30.2 (5.2) (2034)	30.0 (5.2) (2024)
French nationality	1838/2000 (91.9)	1814/1995 (90.9)
Body Mass Index (mean (SD)(n))	22.8 (4.3) (2031)	22.7 (4.1) (2017)
Nulliparous	1074/2030 (52.9)	1031/2010 (51.3)
Previous PPH[a]	43/2030 (2.1)	39/2010 (1.9)
Uterine scar	132/2033 (6.5)	120/2021 (5.9)
Prenatal Hb[b] (g/dL) (mean (SD) (n))	12.0 (1.0) (2005)	12.0 (1.0) (1990)
Prenatal Ht[c] (%) (mean (SD) (n))	35.6 (1.0) (1952)	35.5 (2.9) (1933)
GA[d] at delivery (wks) (mean (SD) (n))	39.4 (1.2) (2034)	39.4 (1.2) (2024)
Induction of labour	381/2034 (18.7)	406/2024 (20.1)
Epidural analgesia	1975/2033 (97.1)	1957/2023 (96.7)
Oxytocin during labour (1^{st} and 2^{nd} stages)	1352/2033 (66.5)	1362/2020 (67.4)
Instrumental delivery	367/2034 (18.0)	381/2024 (18.8)
Episiotomy	597/2034 (29.3)	586/2024 (29.0)
Perineal tear	1036/2033 (51.0)	1024/2024 (50.6)
Birth weight (grams) (mean (SD) (n))	3365 (428) (2032)	3390 (433) (2022)
Birth weight ≥ 4000 grams	159/2032 (7.8)	157/2022 (7.8)

Data are n/N (%) unless otherwise stated

[a] Postpartum haemorrhage

[b] Haemoglobin

[c] Haematocrit

[d] Gestational age

Table 2. Adherence to allocated intervention and other aspects of third stage management

	Controlled Cord Traction	**Standard Placenta Expulsion**
Prophylactic oxytocin administration at birth	1977/2029 (97.4)	1961/2022 (97.0)
Cord clamping and cutting within 2 minutes of birth	1933/2026 (95.4)	1944/2019 (96.3)
Cord management according to protocol	1943/2031 (95.7) [a]	1991/2024 (98.4) [a]
Blood collection bag	2016/2028 (99.4)	2015 (2020 (99.7)
Duration of blood collection (min) (mean (SD) (n))	27 (16) (1990)	29 (16) (1987)
Blood collection bag in place ≥ 15 minutes	1609/2002 (80.4)	1717/1992 (86.2)

Data are n/N (%) unless otherwise stated

[a] The reasons why 88 women in the CCT group and 33 women in the SPE group did not receive the allocated intervention are mentioned in Figure 1

Table 3. Trial outcomes

	Controlled Cord Traction	Standard Placenta Expulsion	Risk ratio (95% CI)	Mean difference (95% CI)
Blood loss ≥ 500mL	196/2005 (9.8)	206/2008 (10.3)	0.95 (0.79-1.15)	/
By hospital			0.31[a]	
A	46/473 (9.7)	37/482 (7.7)	1.27 (0.84-1.92)	/
B	20/199 (10.1)	14/196 (7.1)	1.41 (0.73-2.71)	/
C	40/344 (11.6)	49/330 (14.9)	0.78 (0.53-1.16)	/
D	38/445 (8.5)	42/443 (9.5)	0.90 (0.59-1.37)	/
E	52/544 (9.6)	64/557 (11.5)	0.83 (0.59-1.18)	/
Blood loss ≥ 1000 mL	34/2005 (1.7)	37/2008 (1.8)	0.92 (0.58-1.46)	/
Blood loss at 15 minutes (mL) (mean (SD) (n))	163 (4) (2005)	161 (4) (2001)	/	1.7 (-8.8;12.2)
Total blood loss (mL) (mean (SD) (n))	207 (5) (2005)	217 (6) (2008)	/	-9.4 (-24.8;6.0)
Blood transfusion for PPH	12/2034 (0.6)	9/2024 (0.4)	1.33 (0.56-3.14)	/
Arterial embolization/surgery for PPH	3/2034 (0.1)	5/2024 (0.3)	0.60 (0.14-2.49)	/
Peripartum change in Hb[b](g/dL) (mean (SD) (n))	0.9 (0.0) (1961)	0.9 (0.0) (1953)	/	-0.02 (-0.10;0.07)
Peripartum change in Ht[c] (%) (mean (SD) (n))	2.1 (0.1) (1904)	2.2 (0.1) (1890)	/	-0.05 (-0.29;0.19)
Duration of third stage (min) (mean (SD) (n))	5.5 (0.1) (2030)	8.7 (0.1) (2020)	/	-3.26 (-3.62; -2.90)
Third stage ≥ 15 min	91/2030 (4.5)	289/2020 (14.3)	0.31 (0.25-0.39)	/
Manual removal of placenta	85/2033 (4.2)	123/2024 (6.1)	0.69 (0.53-0.90)	/
Additional uterotonics after placenta delivery	727/2030 (35.8)	805/2024 (39.8)	0.92 (0.83-0.97)	/
Maternal pain during 3rd stage	109/1892 (5.8)	138/1868 (7.4)	0.78 (0.61-0.99)	/
Cord rupture	89/2034 (4.4)	2/2024 (0.1)	44.3 (10.9-179.6)	/

Uterine inversion	0/2034 (0.0)	0/2024 (0.0)	/	/

Data are n/N (%) unless otherwise stated

[a] p for Mantel-Haenszel test of homogeneity across centers

[b] Prepartum Hb measured within 8th month of gestation and arrival in labour ward in 1778 (90.7%) and 1760 (90.1%), at arrival in labour ward in 95 (4.8%) and 99 (5.1%) and between the 5th-7th months of gestation in 88 (4.5%) and 94 (4.8%), in the CCT and SPE groups, respectively ; postpartum Hb measured at Day 2 in 1793 (91.4%) and 1787 (91.5%), and on another day between 1 and 8 days in 168 (8.6%) and 166 (8.5%) , in the CCT and SPE groups, respectively.

[c] Prepartum Ht measured within 8th month of gestation and arrival in labour ward in 1724 (90.5%) and 1707 (90.3%), at arrival in labour ward in 95 (5.0%) and 99 (5.2%) and between the 5th-7th months of gestation in 85 (4.5%) and 84 (4.4%), in the CCT and SPE groups, respectively; postpartum Ht measured at Day 2 in 1737 (91.2%) and 1725 (91.3%), and on another day between 1 and 8 days in 167 (8.8%) and 165 (8.7%) , in the CCT and SPE groups, respectively.

Table 4. Women's experience of third stage

		Controlled Cord Traction	Standard Placenta Expulsion	P[a]
Completed forms		1838/2034 (90.4)	1844/2024 (91.2)	0.41
Felt tired	Not at all	466/1829 (25.5)	426/1838 (23.2)	
	A little	656/1829 (35.9)	621/1838 (33.8)	
	Moderately	378/1829 (20.6)	445/1838 (24.2)	0.017
	Very	252/1829 (13.8)	285/1838 (15.5)	
	Extremely	77/1829 (4.2)	61/1838 (3.3)	
Felt anxious	Not at all	1191/1821 (65.4)	1073/1821 (58.9)	
	A little	398/1821 (21.9)	475/1821 (26.1)	
	Moderately	154/1821 (8.5)	168/1821 (9.2)	<0.001
	Very	59/1821 (3.2)	94/1821 (5.2)	
	Extremely	19/1821 (1.0)	11/1821 (0.6)	
Felt 3rd stage was long	Not at all	1590/1830 (86.9)	1451/1833 (79.2)	
	A little	137/1830 (7.5)	219/1833 (11.9)	
	Moderately	68/1830 (3.7)	110/1833 (6.0)	<0.001
	Very	23/1830 (1.2)	43/1833 (2.4)	
	Extremely	12/1830 (0.7)	10/1833 (0.5)	
Felt satisfied	Not at all	4/1832 (0.2)	3/1840 (0.2)	
	A little	6/1832 (0.3)	11/1840 (0.6)	
	Moderately	63/1832 (3.4)	81/1840 (4.4)	0.21
	Very	716/1832 (39.1)	751/1840 (40.8)	
	Extremely	1043/1832 (57.0)	994/1840 (54.0)	
Discomfort[b]	≤ 2	1408/1830 (76.9)	1285/1834 (70.1)	
	3-7	371/1830 (20.3)	475/1834 (25.9)	<0.001
	≥ 8	51/1830 (2.8)	74/1834 (4.0)	
Pain intensity[c]	≤ 2	1475/1828 (80.7)	1362/1837 (74.1)	
	3-7	309/1828 (16.9)	413/1837 (22.5)	<0.001
	≥ 8	44/1828 (2.4)	62/1837 (3.4)	

Data are n/N (%)

[a] Chi2 test

[b] graded from 0 (no discomfort) to 10

[c] graded from 0 (no pain) to 10